Electron Energy Estimates for Tau Candidate Events

Introduction

Estimating the energy of showers in $\tau \rightarrow e + X$ candidate events has been done using emulsion multiple scattering information, and using SFT / Calorimeter. For the latter, the energy estimates compare the SFT pulse heights and calorimeter energy deposition with the best fit to Monte Carlo-derived distributions. These MC models are an ensemble average of electrons originating either at $x,y = 0$ or over the entire module (although at specific z or radiation length). No regard to initial angle is made.

In this study, MC distributions are again compared to the data, but all the MC events have the initial conditions of position and angle taken from each event to be studied. Effects such as edge effects are automatically taken into account. The primary systematic effect remaining is the lack of any tagged electrons from the data for testing and calibration. MC thresholds, especially in the SFT system, still need to be studied.

Events

Three events in the Phase 1 + 2 combined data set are tau candidates with electrons in the final state. The events are 3024_30175, 3024_18706, and 3333_17665. For each event, 500 to 1000 MC events were generated at fixed energy. The MC events were reconstructed in the standard way and the SFT total pulse heights for each of the four stations were recorded along with the calorimeter energy. For each event and energy, a 2-D distribution in strongly correlated variables was made and compared to data. These plots are included in the pages that follow. An attempt to quantify the analysis was made in the following way. For each event, the binning and number of MC events was identical. Therefore the bin that corresponds to the data is a measure of the probability that this value is expected. This value is found for each of the plots. The maximum value of this probability, as a function of energy, indicates the most likely value. The variables chosen to determine energy were (1) the pulse height in station 3 (P3) versus pulse height in station 4 (P4), and (2) P4 versus the calorimeter total energy.

	3 GeV	4 GeV	5 GeV	6 GeV	9 GeV	Est. E
Peak	0.5	11	20	17	4	5.2±0.8
Ratio	0.02	0.27	0.59	0.58	0.11	5.5±0.9

Estimated Energy for 3024_30175 from P3 vs. P4.

	40 GeV	50 GeV	60 GeV	70 GeV	Est. E
Peak	9	13	12	10	53±12
Ratio	0.5	0.61	0.92	0.61	59±11

Estimated Energy for 3333_17665 from P3 vs. P4.

	40 GeV	50 GeV	60 GeV	Est. E
Peak	8	12	8	50±10
Ratio	0.5	0.58	0.45	49±20

Estimated Energy for 3024_18706 from P3 vs. P4.

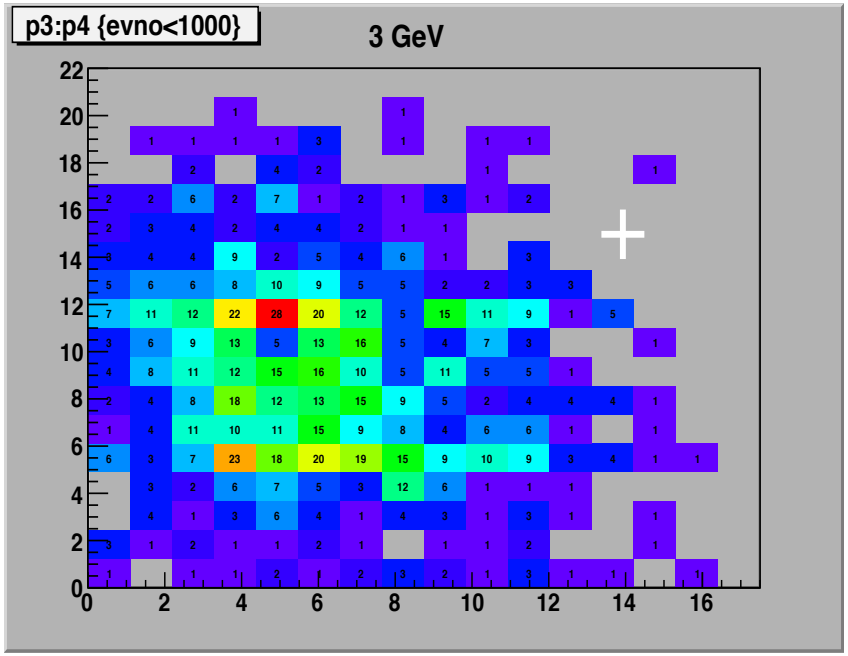

Figure 1. P3 vs P4 for 3024_30175 at 3 GeV.
The cross is the measured SFT pulse height for station 3 vs. station 4.

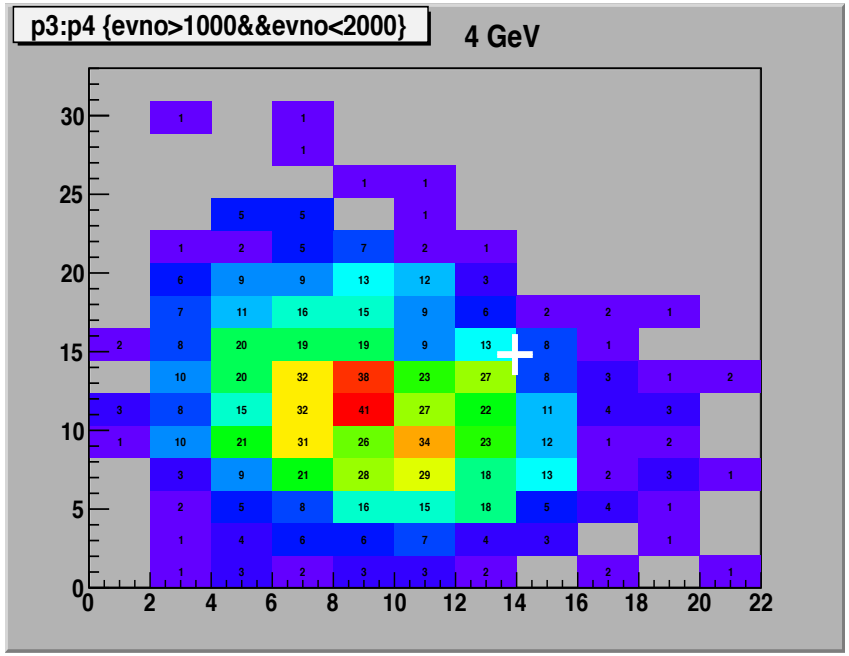

Figure 2. P3 vs P4 for 3024_30175 at 4 GeV.
The cross is the measured SFT pulse height for station 3 vs. station 4.

The energy estimate of event 30175 using calorimeter data has little value since E_{cal} is only 0.3 GeV. The results for the other two events is given in the following table.

Event	Est. Energy
17665	66±8 GeV
18706	46±8 GeV

Estimated Energy using P4 versus total energy in the calorimeter (see Figs. 11 and 15).

Summary

Combining results in quadrature, yields the following estimates for the electron energies:

Event	Est. Energy
17665	59±7 GeV
18706	48±6 GeV
30175	5.3±0.7 GeV

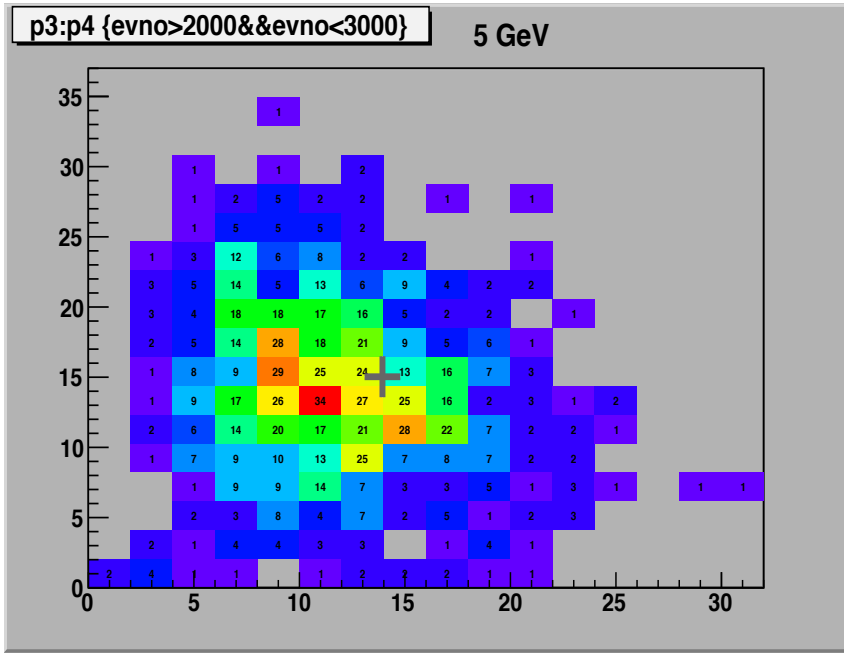

Figure 3. P3 vs P4 for 3024_30175 at 5 GeV.
The cross is the measured SFT pulse height for station 3 vs. station 4.

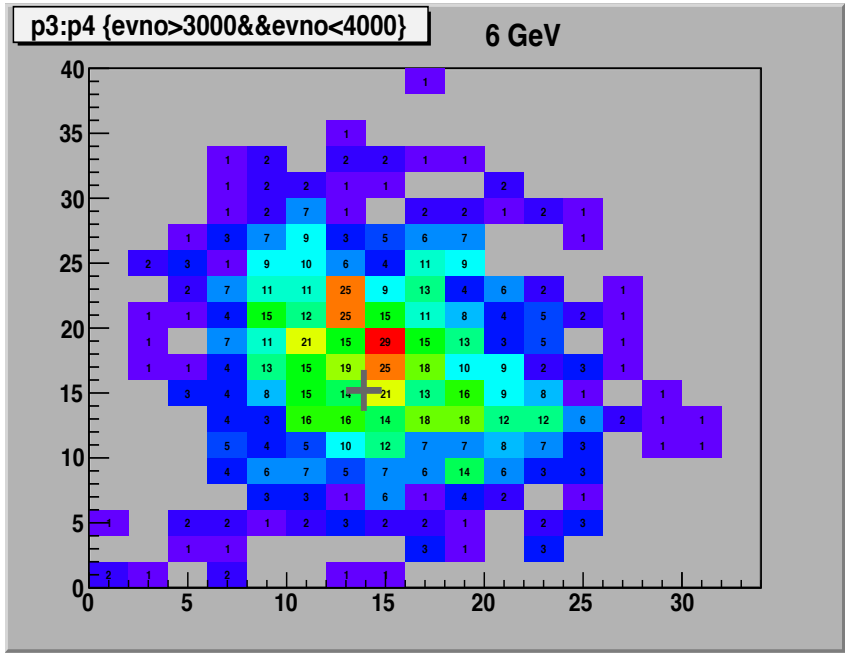

Figure 4. P3 vs P4 for 3024_30175 at 6 GeV.
The cross is the measured SFT pulse height for station 3 vs. station 4.

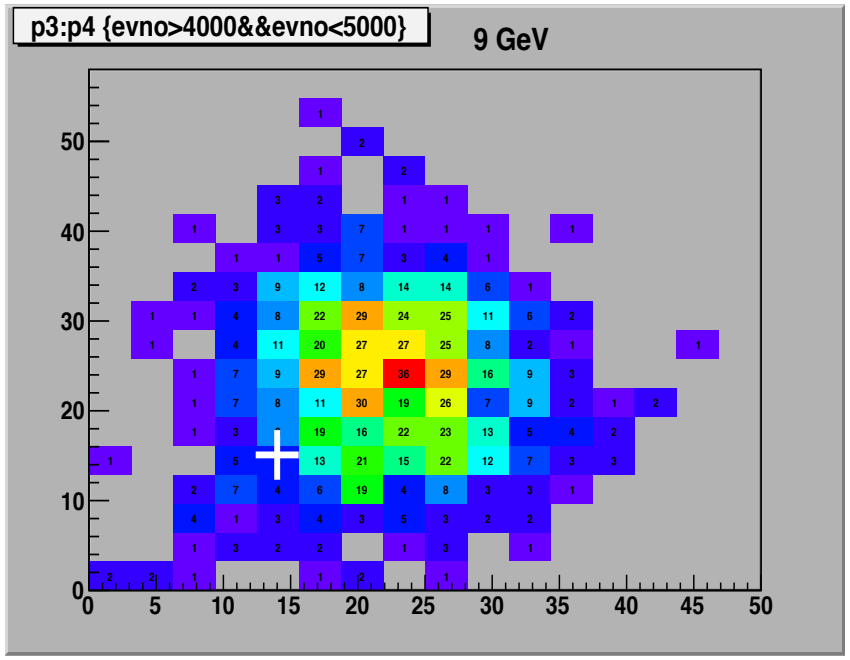

Figure 5. P3 vs P4 for 3024_30175 at 9 GeV.
The cross is the measured SFT pulse height for station 3 vs. station 4.

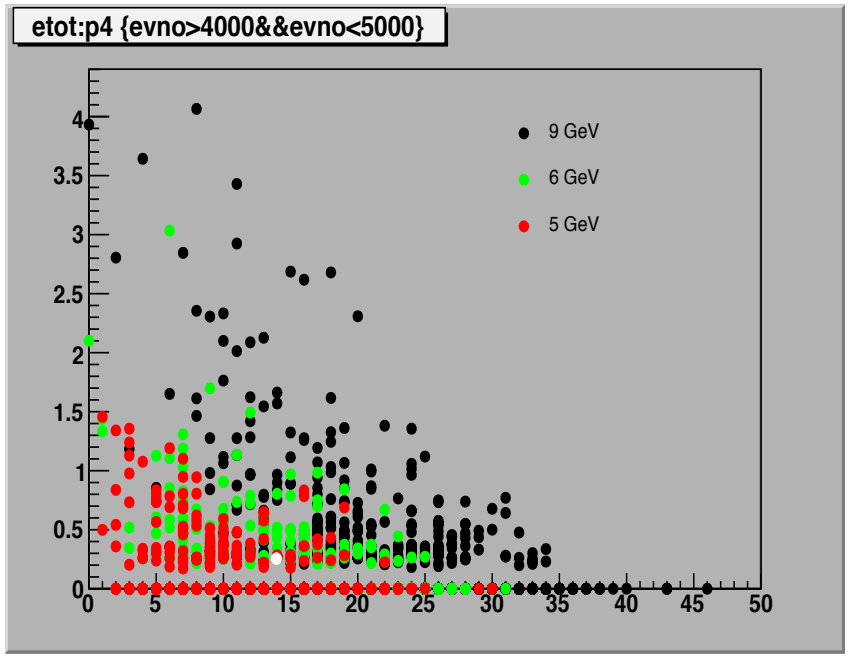

Figure 6. Total Calorimeter Energy vs P4 for 3024_30175.
The white dot is the measured energy in the calorimeter vs. SFT pulse height for station 4.

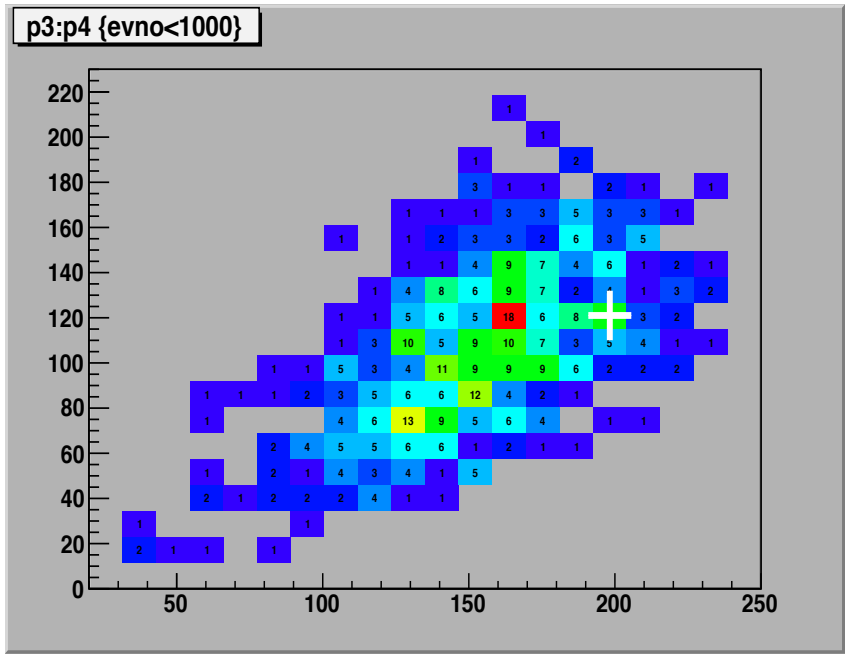

Figure 7. P3 vs P4 for 3333_17665 at 40 GeV.
The cross is the measured SFT pulse height for station 3 vs. station 4.

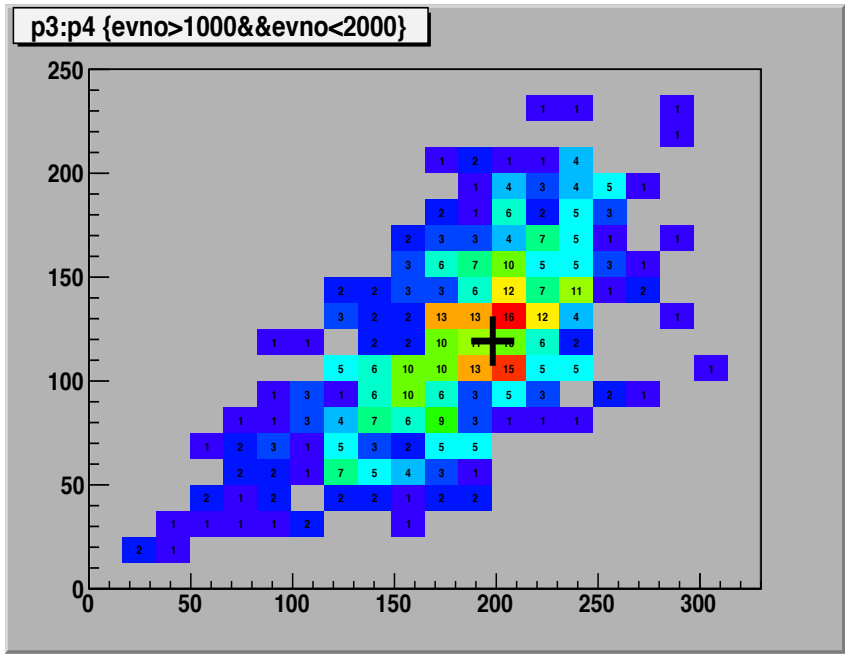

Figure 8. P3 vs P4 for 3333_17665 at 50 GeV.
The cross is the measured SFT pulse height for station 3 vs. station 4.

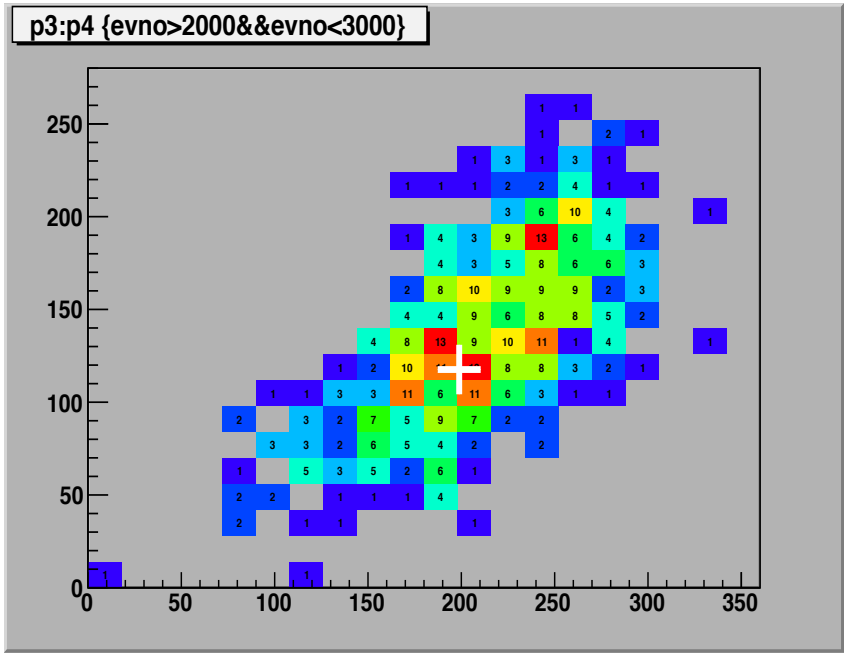

Figure 9. P3 vs P4 for 3333_17665 at 60 GeV.
The cross is the measured SFT pulse height for station 3 vs. station 4.

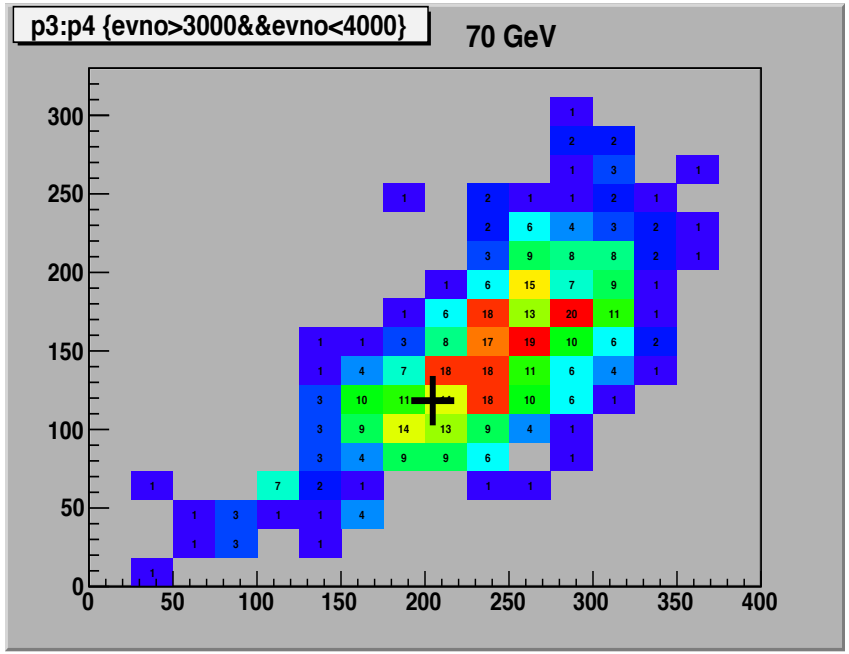

Figure 10. P3 vs P4 for 3333_17665 at 70 GeV.
The cross is the measured SFT pulse height for station 3 vs. station 4.

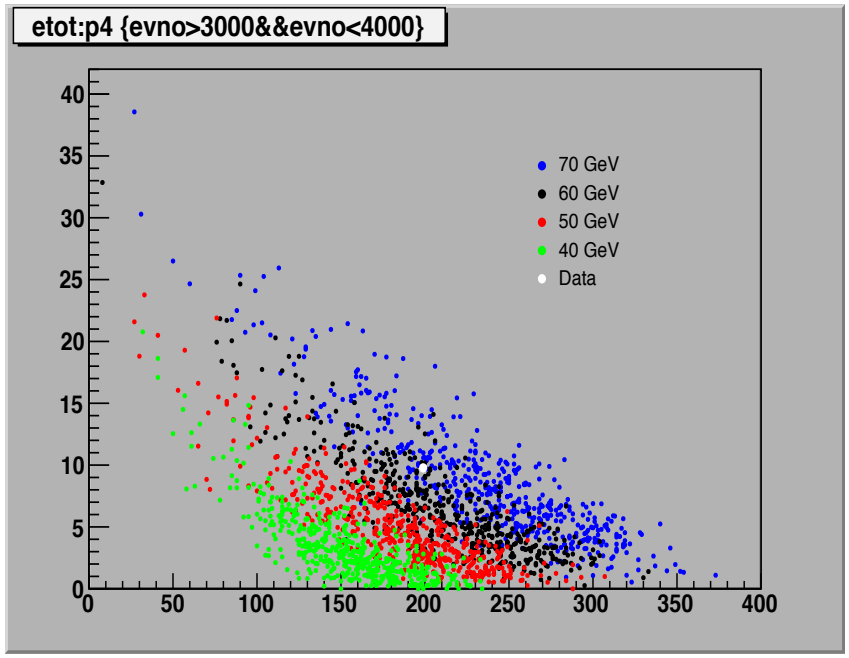

Figure 11. Total Calorimeter Energy vs P4 for 3333_17665.
The cross is the measured energy in the calorimeter vs. SFT pulse height for station 4.

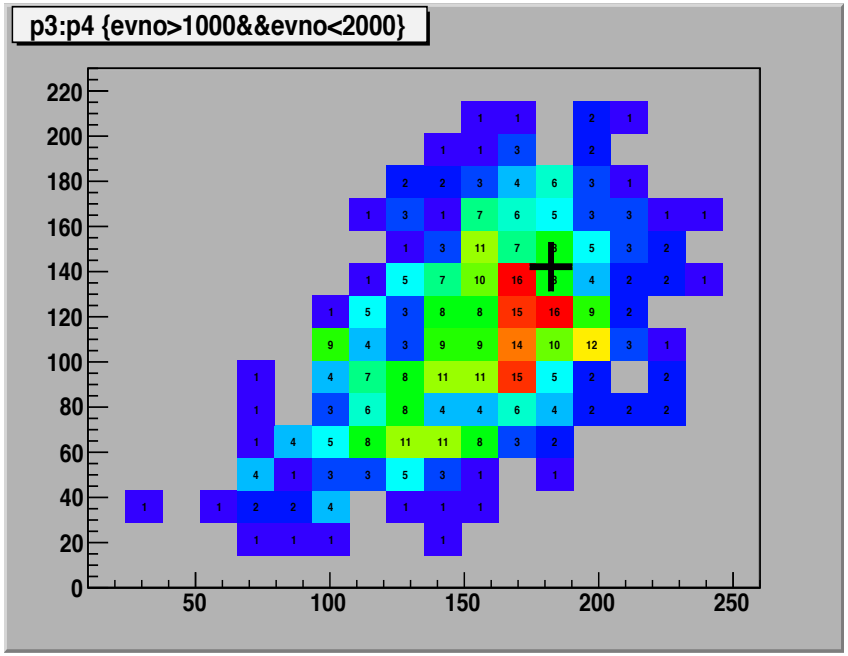

Figure 12. P3 vs P4 for 3024_18706 at 40 GeV.
The cross is the measured SFT pulse height for station 3 vs. station 4.

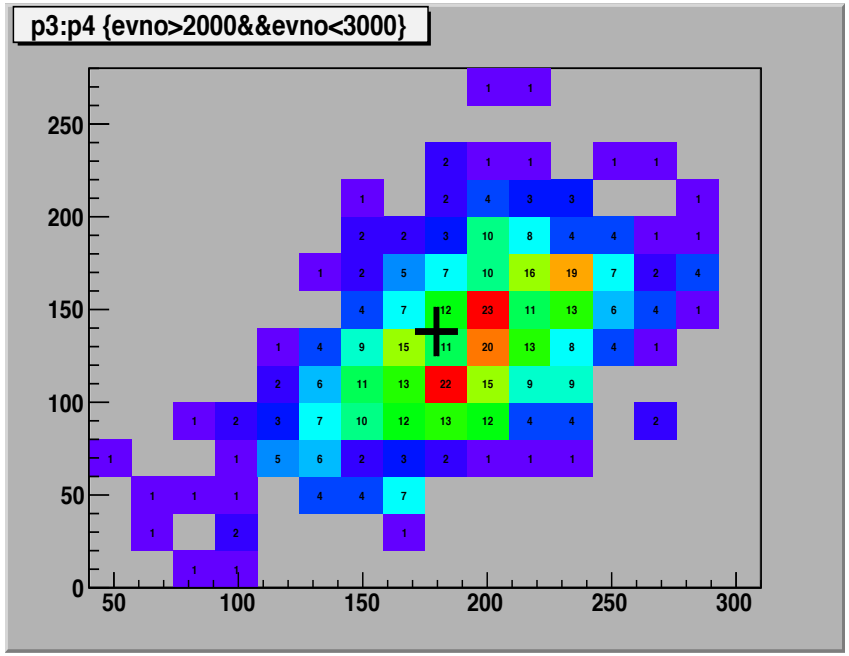

Figure 13. P3 vs P4 for 3024_18706 at 50 GeV.
The cross is the measured SFT pulse height for station 3 vs. station 4.

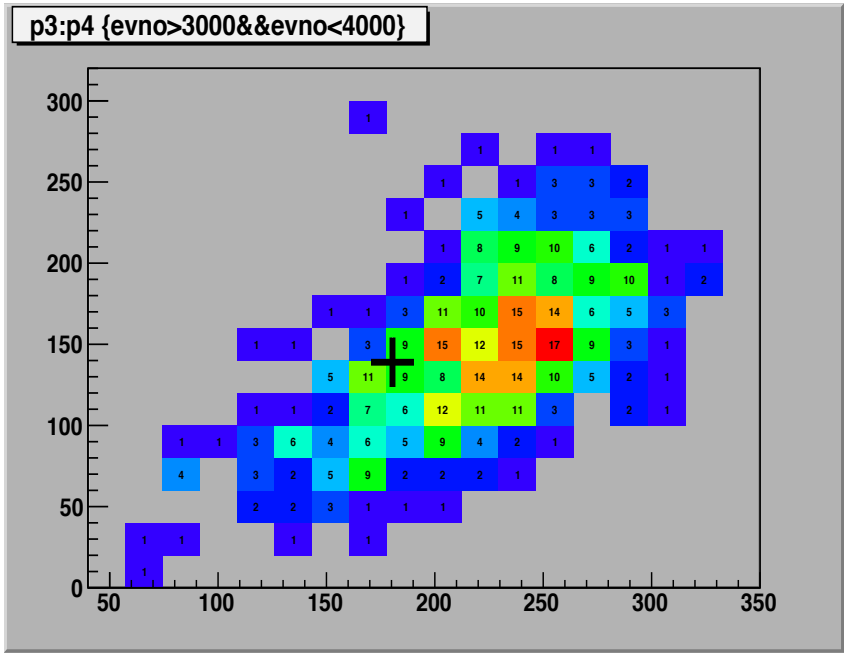

Figure 14. P3 vs P4 for 3024_18706 at 60 GeV.
The cross is the measured SFT pulse height for station 3 vs. station 4.

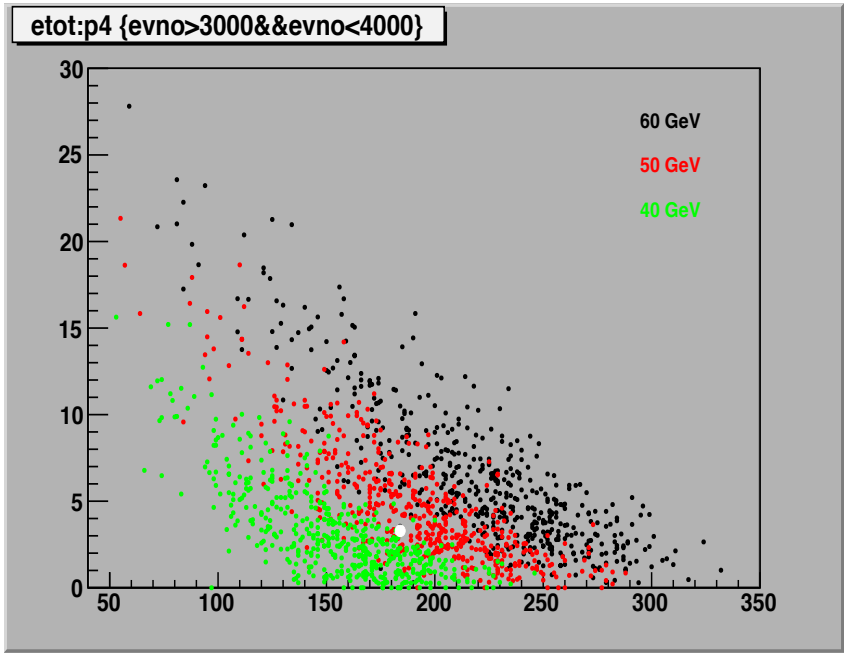

Figure 15. Total Calorimeter Energy vs P4 for 3024_18706.
The cross is the measured energy in the calorimeter vs. SFT pulse height for station 4.